

AD 664833

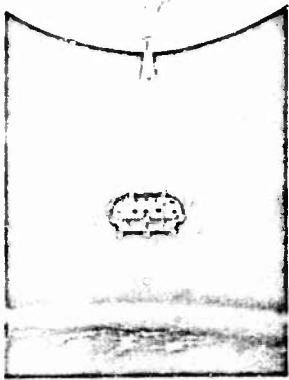
DDC  
RECEIVED  
FEB 7 1968  
RECEIVED  
B

This document has been approved  
for public release and sale; its  
distribution is unlimited.

Reproduced by the  
CLEARINGHOUSE  
for Federal Scientific & Technical  
Information Springfield Va. 22151

68  
WRI

WINZEN RESEARCH INC., MINNEAPOLIS 20, MINNESOTA



# WINZEN RESEARCH INC.

401 WEST EIGHTY-FOURTH ST.  
MINNEAPOLIS, MINN. 55420  
TELEPHONE (612) 881-5871

Final Report

Launch Facility Study

Performed Under  
Contract N00014-67-C-0350  
Contract Authority NR 211-125/1-6-67

For

Office of Naval Research  
Washington, D. C. 20360

26 January 1968

Prepared by: Winzen Research Inc.  
George W. Hoover

Winzen Research Inc.  
401 West 84th Street  
Minneapolis, Minnesota 55420

Reproduction in whole or part is permitted for any purpose of the United States Government.

## TABLE OF CONTENTS

	<u>Page No.</u>
INTRODUCTION	1
TECHNICAL DISCUSSION	2
SUMMARY AND CONCLUSIONS	10
RECOMMENDATIONS	10

Final Report  
Contract N00014-67-C-0350  
Launch Facility Study

INTRODUCTION

Section A of the Statement of Work of the subject contract stated that the contractor . . . "shall conduct a methodical analysis of the national research and development effort related to cosmic ray studies, X-ray and gamma ray astronomy and aeronomical studies to justify a cooperative mobile launch facility for balloons and rockets capable of economical operation in ocean areas. Said research shall include, but not necessarily be limited to, a study of ship launch facilities combined with suitable shore activities and other ships and aircraft for recovery purposes."

To accomplish the above effort, the tasks originally proposed were modified as follows:

Task I - Establish a generalized outline of possible Research and Development effort in order to meet the National Mission objectives.

In accordance with the work statement this task was modified to cover areas related to astronomy and aeronomical studies including some ocean science where this was related to the atmosphere-ocean interface.

Task II - Establish the specific R&D effort being conducted by the various U. S. agencies, to determine overlap and duplication of programs and the areas of effort not presently being covered.

This task was also modified to limit the coverage to astronomical and aeronomical studies.

Task III- Establish the types of facilities necessary to conduct acceptable programs within the various R&D areas of effort.

Task IV - Establish the facilities presently being employed by the various agencies in their R&D programs and from this determine the overlap and duplication of these facilities.

Task V - Develop an objective organization of Integrated Research and Develop--

ment Units which if employed would reduce overlap, redundancy and duplication of effort and facilities, increase our R&D scope of effort, and increase the effectiveness of the overall National Research and Development Program.

Tasks III through V were also modified to meet the work statement but also included consideration of additional research facilities other than just those required for launching balloons and rockets.

Each of the tasks were completed with the exception that Task II. could have been more extensive if more information relative to the projects of agencies other than CNR, could have been acquired. Although considerable difficulty was encountered in attempting to gather data concerning active projects, sufficient knowledge was obtained from various National Academy of Sciences reports to permit extrapolation of enough information to be used as examples in the subject analysis.

It is believed that the results of the analysis not only justifies a cooperative mobile launch facility for balloons and rockets capable of economical operation in ocean areas, but in addition, the findings demonstrate a research facility capable of reducing overlap, redundancy, and duplication of effort and at the same time increasing the scope of research effort and effectiveness.

#### TECHNICAL DISCUSSION

The study utilized a very specific method of analysis. Rather than describing the methodology separately, the discussion which follows will bring out the basic concepts of the methodology by showing how they were applied to the problem at hand.

Basically the methodology employs a technique for examining a complex problem in an orderly and systematic way so that bias and opinion is minimized in favor of logic based upon fundamental relationships. To determine these fundamental relationships it is necessary first to define the factors involved in a relationship, and second, to define the nature of the relationship itself.

In this instance we are concerned with various aspects of astronomical and aeronautical research.

The primary factors involved then are the constituents of the universe and the atmosphere, and phenomenological characteristics. The relationships we seek to understand are the specific characteristics which are pertinent to each of the constituents. To implement the determination of the fundamental relationships, a matrix consisting of the two sets of factors was utilized, which for purposes of this analysis provided a means for identifying the objectives of the various research projects being examined.

In addition to the specific research objectives, we are also concerned with the means and methods for conducting the research effort. The factors involved here are the projects themselves and the facilities, vehicles and support services required to execute the research projects. The relationships are then the correlation of these two sets of factors which were determined by a second matrix. This second matrix provided a means for establishing the specific facilities, vehicles, and support services being utilized by each of the research projects.

A third area of concern which is most pertinent to the problem is the determination of methods for maximizing the efficiency of astronomical and aeronautical research effort. In this instance one set of the factors involved consists of the facilities, vehicles, and support services, and the other set comprises the operational parameters such as availability, flexibility, capability, and cost. In order to equate these factors, a third matrix was developed which permitted an examination of the operational parameters relative to the major classes of facilities, vehicles, and support services which in turn established the optimal class for the subject type of operation.

The remaining steps in the analytical procedure consisted primarily of applying the results of the previous effort to determining the requirements for the cooperative facility and to justifying its effectiveness by relating the facility capabilities to specific project requirements. Before expanding on these latter steps, it is necessary to return to a more detailed description of the matrices previously referred to and

explain how they were developed.

One of the concepts upon which the employed analytical technique is based is that any entity within our total environment can be treated as an element of an hierarchial distribution ranging from macroscopic to microscopic proportions. Since an understanding of these entities within the environment is the objective of research, and when the domains of the environment being examined are as extensive as they are in astronomy and aeronomy, it becomes necessary to carefully identify and categorize each of the entities within the selected range of the total hierarchial distribution. To accomplish this, a selection and classification of terms was prepared as follows:

1. The first level was divided into Space, Space/Atmosphere Interface, Atmosphere, Atmosphere/Hydrosphere Interface, Hydrosphere, Hydrosphere/Lithosphere Interface, Lithosphere, and Lithosphere/Atmosphere Interface.

2. At the second level, Space was further divided into Extra Galactic, Galactic, Planetary, Solar, Lunar and Interstitial Space. Atmosphere was divided into Exosphere, Heterosphere, Thermosphere, Ionosphere, Mesosphere, Homosphere, Chemosphere, Stratosphere, Ozonosphere and Troposphere. Hydrosphere was categorized as Surface Layers and Deep Layers, and the Lithosphere was divided into the Sediments, Crust, and Mantle.

3. Since each domain is comprised of Gaseous, Liquid and Solid Forms along with Energy Forms, these terms were used to define the next lower level.

4. The last level consisted of the specific types of Gaseous, Liquid, Solid and Energy Forms which will not be listed in the text of this discussion but can be found on Fig. 1, along the horizontal axis.

Since an understanding of any entity in the environment is dependent upon knowledge of its characteristics, any research effort can only be identified by determining the specific characteristics of the entity being examined. It is necessary then to also identify and categorize these characteristics.

The selection and classification of terms to represent the overall characteristics was prepared as follows:

1. The first level was divided into Determination of Constituents, the



Synoptic Factors, and the Dynamic Factors.

2. The second level was divided into Structure and Properties with a further division of Properties into Mechanical, Electromagnetic, Thermodynamic, Chemical, and Biological.

3. Each of the second level terms were further categorized by the pertinent specific fundamental physical terms. In the interests of keeping the text of this discussion as short as possible these terms are not listed but can be found along the vertical axis of Fig. 1.

Taking the terms as described above, the first matrix (Fig. 1) was prepared. This represents the fundamental relationships which constitute Astronomical and Astronomical Research and to some extent Ocean Sciences Research. The utilization of Fig. 1 will be explained later in the report.

To deal with the second set of relationships with which we are concerned, i.e., the means and methods for conducting research, a compilation of terms was prepared to represent the facilities, vehicles, and support services as follows:

1. The first level was divided with respect to the operational media, i.e., Land, Sea, Air and Space.

2. Each of the above were further divided into Facilities, Vehicle Operations, Deployed Vehicle Operations, and Support Services.

3. The second level terms were further divided into more specific terms as shown in Fig. 2.

The second set of factors, namely, the projects could not be categorized in general terms but provision was made in preparing the matrix (Fig 2) for classifying each project relative to the Agency, Work Unit Number, Specific Characteristic/Specific Constituent, Work Unit Cost, and Support Cost. The utilization of Fig. 2 will be explained later in the report.

The third area of concern was the relationship of operational parameters relative to the facilities, vehicles, and support services to determine methods for maximizing the research effort. The terms for facilities, vehicles, and support



services were already established (See Fig. 2). An additional set of terms representing the operational factors was developed as follows:

1. The first level was divided into Capability, Flexibility, Availability and Cost.

2. The second level under Capability was further divided into Facilities, Vehicle Operations, Deployed Vehicle Operations, and Support Services. Under Flexibility the divisions are Geographical Coverage, Local Area Coverage, Mobility, Individual Observations, and Simultaneous Observations. Availability was divided into Number of Months, Number of Days, Day Operations, Night Operations, and All Weather Operations. Cost was divided into Initial and Operational.

3. The only third level breakdown applied to Individual and Simultaneous Observations under Flexibility and each was further divided into the Areas of Research, i.e. Space, Space/Atmosphere Interface, Atmosphere, etc.

#### Utilization of the Matrices

Starting with Matrix 1 (Fig. 1) a series of columns were added to the right hand side of the matrix under Project Work Unit Code with the following headings: Project/Work Unit Number, Type of Effort, Specific Characteristic/Specific Constituent, Operation Facility or Vehicle, Support Facility or Vehicle, Geographic Location, and Cost.

These columns were used to record the various astronomical and atmospheric research work units furnished by the Physics Branch, ONR. An additional set of work units from Code 408 on Ocean Sciences were also recorded as well as projects for agencies other than ONR which were extrapolated from National Academy of Sciences reports.

Each of the projects were coded as follows: The first set of digits in column one represent the major intersection of the matrix which best identified the research effort. For example, 09/17 would indicate that the work unit consisted of research relative to the Dynamic Mechanical Properties of the Stratosphere. The number recorded under this set of digits indicates the work unit number as shown on the

1498 form. The number recorded in the second column indicates the type of effort being conducted. The first eight numbers displayed under the Code along the horizontal axis represents the various types of effort. For example if the number 04 appeared in the second column it would mean that the work unit called for Field Observation and Experiments.

The third column was used to denote the Specific Characteristic and the Specific Constituents using the Codes along the vertical and horizontal axes. For example, if the entry were 08/20 it would mean that the work unit involved examination of the Velocity of Vertical Winds.

The fourth column was used to record the Operational Facility or Vehicle, the code being taken from numbers 119 through 133 from the horizontal axis code. The fifth column indicated the Support Facility or Vehicle taken from the horizontal code from numbers 119 through 148 since Instrumentation and Equipment was also considered as supporting effort. Thus if columns four and five showed the numbers 129 and 119 respectively it would indicate that the work unit called for the operation to be carried out by a Balloon and operated from a supporting Land Base.

The sixth column was used to indicate the Geographical Location of the effort such as Palestine, Texas. The seventh column was used to indicate the work unit funding in thousands of dollars.

In summary then if the code appeared in the columns as;

09/17  
211-096 - 04 - 08/20 - 129 - 119 - Palestine, Texas - 50

it could be read out as a Physics Branch work unit investigating the dynamic mechanical properties of the stratosphere by conducting field observations, specifically with respect to the velocity of vertical winds, with a balloon operating from a land base at Palestine, Texas at a cost of \$40,000.

In addition to the coding, the work unit numbers were also recorded in the appropriate intersections on the matrix.

Matrix 1 (Fig. 1) has many uses. When work units are recorded in the intersections it shows the distribution of effort, areas of heavy concentration, and areas where no activity is being conducted. If all agencies projects were also recorded it would show areas of overlap and areas of duplication. To determine whether duplication exists, it is only necessary to refer to the codes for each of the projects in question to determine the specific characteristic and specific constituent being examined, or the operating facility or support facility, equipment being used, or the geographical location.

In this analysis the matrix was utilized to define each of the work units examined. It can also be utilized as a guideline to prepare new 1498 forms.

When large numbers of work units are being administered, the matrix coding provides the programming information for computerizing the data handling.

For the subject analysis, however, the reason for recording the work units was primarily to establish the various factors and relationships relevant to the study objectives. Specifically the exercise was carried out in order to define the work units in terms of the factors required for utilization of Matrix 2 (Fig. 2)

Referring to Matrix 2, the work units were recorded along the vertical axis as coded in Matrix 1. Each work unit was then examined relative to the Facilities, Vehicles, and Support Services as indicated on the horizontal axis. Wherever a specific facility, operational vehicle, deployed vehicle, etc. was found to be either stated as being utilized or found by inference to be required, the appropriate intersection was marked.

Further analysis of the distribution of the marked intersections provided the means for establishing a reasonably accurate list of the facilities, vehicles, and support services required for effective astronomical and aeronautical research.

It is obvious that a broader coverage of research work units would provide a more thorough delineation of the facilities, vehicles, and support services required, but the work units which were recorded, represent enough of the research spectrum to establish the general requirements.

The next step in the analysis was to determine the most effective and economical

combination of facilities which could be organized and operated as a cooperative effort. To do this, Matrix 3 (Fig. 3) was examined and coded to establish which of the various types of facilities, vehicles, and support services provided the greatest capability, flexibility, availability and lowest operational cost.

When the distribution of marked intersections on Matrix 3 was analyzed it became obvious that a combination of ships can provide the greatest concentration of capability, the most flexibility, and the maximal availability. Although information relative to cost was not available for this analysis, it can be hypothesized that since a ship is essentially a mobile base of operations the operating cost for one ship would certainly be less than the operating cost of several land bases. It is believed that if operating cost figures could be made available, a relatively modest analysis would show a very significant reduction in the cost of conducting the subject type of research by employing ships, as opposed to the cost of operating the relatively large number of land bases presently being utilized.

The final steps of the analysis consisted of preparing Matrix 4 (Fig. 4) which shows the advantages of a research fleet of ships by correlating the various ship facilities with the facilities necessary for conducting astronomical and aeronautical research as well as land and ocean sciences research. One properly fitted aircraft carrier made available for research would provide a definite increase in research capability. Additional benefits would be added in proportion to the number and type of ships added to the research fleet complex.

To further justify the advantages which could be gained from a fleet of research ships, Matrix 5 (Fig. 5) was prepared in which those work units specifying field observation and operations were plotted relative to the capabilities of the units of the proposed ship complex. It is quite evident that all of these projects could be executed with a single aircraft carrier as the operating support facility. It is also believed that the research results could be more extensive and that the overall time for conducting the projects could be greatly reduced.

### SUMMARY AND CONCLUSIONS

The effort as described in the report produced the following results.

1. A generalized outline of the major factors and relationships relative to astronomical and aeronautical research was established and in addition was prepared in the form of a matrix which can be very useful in management of pertinent research programs.
2. An analysis of the ONR research work units was accomplished which identified the individual work unit effort and provided a distribution of these projects relative to the subject research areas.
3. A delineation of the facilities, vehicles and support services required for astronomical and aeronautical research was achieved and served to justify the utilization of a research oriented ship complex.
4. A cooperative mobile launch facility for balloons and rockets capable of economical operation in ocean areas was also justified and could be achieved with a single aircraft carrier.

### RECOMMENDATIONS

As hypothesized in the proposal, one of the greatest sources of information relative to the nature of any entity within our range of observation, lies at the interface of that entity with another. In reviewing the present effort being conducted in astronomy, aeronomy, and ocean sciences, there appear to be very few work units related to the major interfaces of land, sea, air and space. This is probably due in part to a lack of coordination of the various scientific disciplines but it is believed to be primarily due to the lack of a facility to accomplish the observations required.

It is recommended that a project be established in which an aircraft carrier is assigned to operate in company with ocean science research vessels and coordinate with the earth satellite program. Such a combination of facilities would permit


simultaneous launching of a number of free and tethered balloons as well as deploying sounding units from the ocean science vessels. If the balloons and sounding units were programmed to level off at specified altitudes and depths, a series of measurements could be achieved almost simultaneously from the ocean bottom to the top of the atmosphere. If these measurements could be coordinated with the transit of an earth satellite, the measurement of energy and energy exchange as well as other parameters could be achieved at each of the major environmental interfaces.

It is believed that the results which could be realized from such an experiment would completely justify the concept of a mobile research facility and promote greater coordination of the research agencies.

It is further recommended that the subject analysis be extended to acquire additional work unit information from agencies other than ONR in order to permit a broader coverage of the subject research, and to expand the matrices to greater levels of detail.



Unclassified  
Security Classification

DOCUMENT CONTROL DATA - R&D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author) Winzen Research Inc. 401 West 84th Street Minneapolis, Minnesota 55420		2a. REPORT SECURITY CLASSIFICATION Unclassified
3. REPORT TITLE Final Report - Launch Facility Study		2b. GROUP
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report		
5. AUTHOR(S) (Last name, first name, initial) Hoover, George W.		
6. REPORT DATE 26 January 1968	7a. TOTAL NO. OF PAGES 13	7b. NO. OF REFS 0
8a. CONTRACT OR GRANT NO. N00014-67-C-0350	9a. ORIGINATOR'S REPORT NUMBER(S)	
8b. PROJECT NO.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned to this report)	
10. AVAILABILITY/LIMITATION NOTICES Qualified requesters may obtain copies of this report from DDC.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Office of Naval Research Physics Branch Physical Sciences Division	
13. ABSTRACT Contract N00014-67-C-0350 was awarded to conduct a methodical analysis of the national research and development effort related to cosmic ray studies, X-ray and gamma ray astronomy and aeronautical studies to justify a cooperative mobile launch facility for balloons and rockets capable of economical operation in ocean areas. The study includes, but is not limited to, ship launch facilities combined with suitable shore activities and other ships and aircraft for recovery purposes.  Results justify the above objectives and, in addition, demonstrate a research facility capable of reducing overlap, redundancy and duplication of effort and, at the same time, increase the scope of research effort and effectiveness. (1) 		



1c. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Launch Facility Cosmic Ray X-Ray Astronomy Ships Aircraft Astronomical Aeronomical Balloons Rockets Atmospheric constituents						

### INSTRUCTIONS

**1. ORIGINATING ACTIVITY:** Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*corporate author*) issuing the report.

**2a. REPORT SECURITY CLASSIFICATION:** Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

**2b. GROUP:** Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

**3. REPORT TITLE:** Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

**4. DESCRIPTIVE NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

**5. AUTHOR(S):** Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

**6. REPORT DATE:** Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

**7a. TOTAL NUMBER OF PAGES:** The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

**7b. NUMBER OF REFERENCES:** Enter the total number of references cited in the report.

**8. CONTRACT OR GRANT NUMBER:** If appropriate, enter the applicable number of the contract or grant under which the report was written.

**9a, 9b, & 9d. PROJECT NUMBER:** Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

**9a. ORIGINATOR'S REPORT NUMBER(S):** Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

**9b. OTHER REPORT NUMBER(S):** If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).

**10. AVAILABILITY/LIMITATION NOTICES:** Enter any limitations on further dissemination of the report, other than those

imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign announcement and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through \_\_\_\_\_."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through \_\_\_\_\_."
- (5) "All distribution of this report is controlled. Qualified DDC users shall request through \_\_\_\_\_."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

**11. SUPPLEMENTARY NOTES:** Use for additional explanatory notes.

**12. SPONSORING MILITARY ACTIVITY:** Enter the name of the departmental project office or laboratory sponsoring (*paying for*) the research and development. Include address.

**13. ABSTRACT:** Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

**14. KEY WORDS:** Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical content. The assignment of links, roles, and weights is optional.

A

FACILITIES — VEHICLES — SUPPORT SERVICES						LAND																						
						FACILITIES									LAND VEHICLE OPERATIONS	DEPLOYED VEHICLE OPERATIONS							SUP					
						RESEARCH LABORATORIES	DEVELOPMENT LABORATORIES	OPTICAL OBSERVATORIES	RADAR / RADAR OBSERVATORIES	PHYSICAL OBSERVATORIES	TRACKING	COMMUNICATIONS	DATA PROCESSING	SIMULATION & TESTS	SUBTERRANEAN	SURFACE	FIXED WING AIRCRAFT	ROTARY WING AIRCRAFT	SOUNDING / ROCKETS	BOOSTERS / SPACECRAFT	BALLOONS					PERSONNEL	MAINTENANCE & REPAIR	CONSTRUCTION
AGENCY	CONTRACTOR	PROJECT OR WORK UNIT NUMBER	SPECIFIC CONSTITUENT SPECIFIC CHARACTERISTIC	WORK UNIT COST (THOU.)	SUPPORT COST (THOU.)	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	
ONR	CONVAIR	211026	OVERALL CHARACTERISTICS ATM. GENERAL.	?		01																						
ONR	CONVAIR	211026	OVERALL CHARACTERISTICS SOLAR GAMMA RAY RADIATION	?		02																						
ONR	GEN. MILLS	211033	OVERALL CHARACTERISTICS BALLOONS, CONTROL INSTR.	23		03																						
ONR	GEN. MILLS	211055	VELOCITY, MASSES OF WIND, TEMPS. MOTION, THERMAL MOTION	35		04																						
ONR	A.B. LITTLE	211064	MECHANICAL DYNAMICS BALLOONS	50		05																						
ONR	U.S. WEATHER BUREAU	211065	DETERMINATION OF CONSTITUENTS GENERAL ATM.	3		06																						
ONR	COLUMBIA UNIV.	211067	GEOMETRY, MATERIALS BALLOONS	21		07																						
ONR	NRL	211068	STRUCTURE WATER VAPOR, OZONE	0		08																						
ONR	RAVEN INDUSTRIES	211069	OVERALL CHARACTERISTICS ATM., COSMIC RAYS, BALLOONS, CONTR.	11		09																						
ONR	WINTEK RESEARCH	211070	FLIGHT TRAINING	0		10																						
ONR	RAVEN INDUSTRIES	211075	MECHANICAL DYNAMICS STRATOSPHERIC WINDS	5		11																						
ONR	SCHLIDBAHL	211076	OVERALL CHARACTERISTICS BALLOONS (HEAVY LOAD)	40		12																						
ONR	RAVEN INDUSTRIES	211077	OVERALL CHARACTERISTICS ATM., COSMIC RAYS, BALLOONS, CONTR.	350		13																						
ONR	WINTEK RESEARCH	211078	OVERALL CHARACTERISTICS COSMIC RAYS, BALLOONS, CONTR.	44		14																						
ONR	NRL	40-125	OVERALL CHARACTERISTICS GAMMA RAY & NEUTRON DETECTOR	30		15																						
ONR	NAS MONN.	211-016	LOGISTIC SUPPORT	2		16																						
ONR	GENERAL DYNAMICS	211-026	OVERALL CHARACTERISTICS UPPER ATM. PHYSICS	0		17																						
ONR	SCHLIDBAHL	211-088	OVERALL CHARACTERISTICS BALLOON (10 MILLION FT <sup>3</sup> )	42		18																						
ONR	SCHLIDBAHL	211-093	SUPPORT BALLOON FLTS, HEAVY NUCLEI	28		19																						
ONR	BU. OF STD.	211-096	ELECTROMAGNETIC PROPERTIES INFRARED RADIATION	10		20																						
ONR	WINTEK RESEARCH	211-097	SUPPORT BALLOON FLTS, RADIATION	418		21																						
ONR	SCHLIDBAHL	211-098	PRECIPITATION ELECTRONS	116		22																						
ONR	JOHN'S HOPKINS U.	211-099	SPECTRUM SOLAR RADIATION, DATA REDUCTION	65		23																						
ONR	RAVEN INDUSTRIES	211-100	SUPPORT AIRCRAFT, BALLOON TRACKING	59		24																						
ONR	UNIV. OF CALIF.	211-101	LOGISTIC SUPPORT	?		25																						
ONR	SPACE / RESEARCH CORP.	211-102	OVERALL CHARACTERISTICS ROCKETS, COSMIC WEATHER BUDS	27		26																						
ONR	RAVEN INDUSTRIES	211-103	OVERALL CHARACTERISTICS BALLOON FLT. FOR GALACTIC COSMIC RAYS	75		27																						
ONR	MOTS, CHANA LABEL, CALIF.	211-104	OVERALL CHARACTERISTICS TETHERED BALLOONS	13		28																						
ONR	FLORIDA STATE U.	082-071	THERMODYNAMICS ROTARY AIR MOTIONS	28		29																						
ONR	N.M. INST. OF MINING	082-094	ELECTRIC POTENTIAL WATER CONTAMINANTS, ICE	29		30																						
ONR	JOHN'S HOPKINS U.	082-104	MECHANICAL PROPERTIES GAS & LIQUID MOTIONS	27		31																						
ONR	WOODS HOLE OCEAN INST.	082-124	CHARGE WATER DROPLETS	18		32																						
ONR	INST. OF ATM. PHYSICS	082-154	THERMODYNAMICS AIR MIXTURES, THERMAL, RADON	20		33																						
ONR	INST. OF ATM. PHYSICS	082-164	OVERALL CHARACTERISTICS ATM. WATER DROPLETS, ICE CRYSTALS	38		34																						
ONR	N.M. INST. OF MINING	082-167	ELECTROMAGNETIC PROPERTIES THUNDERSTORMS, ENERGY ETC.	25		35																						
ONR	FLORIDA STATE U.	082-172	MECHANICAL PROPERTIES ATM & FLUID CIRCULATION	60		36																						
ONR	PERMUTICS	082-176	OVERALL CHARACTERISTICS ATMOSPHERE, ATM., WATER, VAPOR SURFACES, IMPULSION	25		37																						
ONR	N.M. INST. OF MINING	082-178	ACOUSTICAL FREQUENCY THUNDERSTORM PRESS. & TEMPERATURES	13		38																						

FACILITIES

SEA

[illegible]







E

## SPACE

	FACILITIES	AIR VEHICLE OPERATIONS	DEPLOYED VEHICLE OPERATIONS	SUPPORT SERVICES	GEOGRAPHICAL LOCATION
00	RESEARCH LABORATORIES DEVELOPMENT LABORATORIES (FUTURE)	SPACE PROBES	SPACE PROBES	PERSONNEL (FUTURE)	
01	OBSERVATIONS RADIO / RADAR OBSERVATORIES PHYSICAL OBSERVATORIES TRACKING COMMUNICATIONS DATA PROCESSING SIMULATION & TEST (FUTURE)	BOOSTERS EARTH ORBITING SATELLITES STATIONS SOLAR ORBITING SATELLITES STATIONS PATTERNS ORBITING SATELLITES & STATIONS SPACECRAFT	BOOSTERS LIFTING BODIES BALLOONS	MAINTENANCE & REPAIR (FUTURE) CONSTRUCTION (FUTURE) FOOD & HOUSING MEDICAL (FUTURE) SUPPLY (FUTURE) RECOVERY RESERVE & SURVIVAL (LIMITED) ADMINISTRATION (FUTURE) RECREATION (FUTURE)	
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					





TUCSON  
ARIZONA  
TUCSON  
ARIZONA  
SOCORRO  
NEW MEXICO  
TALLAHASSEE  
FLORIDA

MASS

SOCORRO  
NEW MEXICO  
TUCSON  
ARIZONA

BUFFALO N.Y.

FORT COLLINS  
COLORADO

TUCSON ARIZONA  
SONORAN DESERT  
GARDEN  
ZUBSPITZ & WALK PL.

DURHAM  
ENGLAND  
MENLO PARK  
CALIFORNIA

X HAWAII

WASH. D.C.

TUCSON ARIZ.

SANTA BARBARA  
CALIF.

SANTA ANA  
CALIF.

N.Y. N.Y.

PASADENA  
CALIF.

RENO  
NEVADA

BUFFALO N.Y.

BERKELEY  
CALIF.

BEDFORD  
MASS.

SOCORRO  
NEW MEXICO

FLORIDA

ALBANY, N.Y.

MASS.

PROVIDENCE  
RHODE ISLAND

FLORIDA

SANTA BARBARA  
CALIF.

RIVER FOREST  
ILLINOIS

SAN DIEGO  
CALIF.  
BALTIMORE  
MARYLAND  
COLLEGE STATION  
TEXAS

COLLEGE STATION  
TEXAS  
COLLEGE STATION  
TEXAS

N.Y., N.Y.

N.Y., N.Y.

MIAMI  
FLORIDA  
CORVALLIS  
OREGON

?

?

?

?

?

?

?

?

?

?

?

?

?

?

?

TROPICS  
CHESAPEAKE  
BAY  
GULF OF  
MEXICO  
GULF OF  
MEXICO  
EAST TROPICAL  
PACIFIC  
LONG ISLAND  
SOUND  
?  
BAHAMA  
BANKS  
?

H

HAWAII

TROPICS  
CHESAPEAKE  
BAY  
GULF OF  
MEXICO  
GULF OF  
MEXICO  
EAST TROPICAL  
PACIFIC  
LONG ISLAND  
SOUND  
?  
BAHAMA  
BANKS  
?

?  
?  
?  
?  
?  
?  
?  
?  
?  
?

12 STATIONS FROM  
CAN. Z. TO GREENLAND

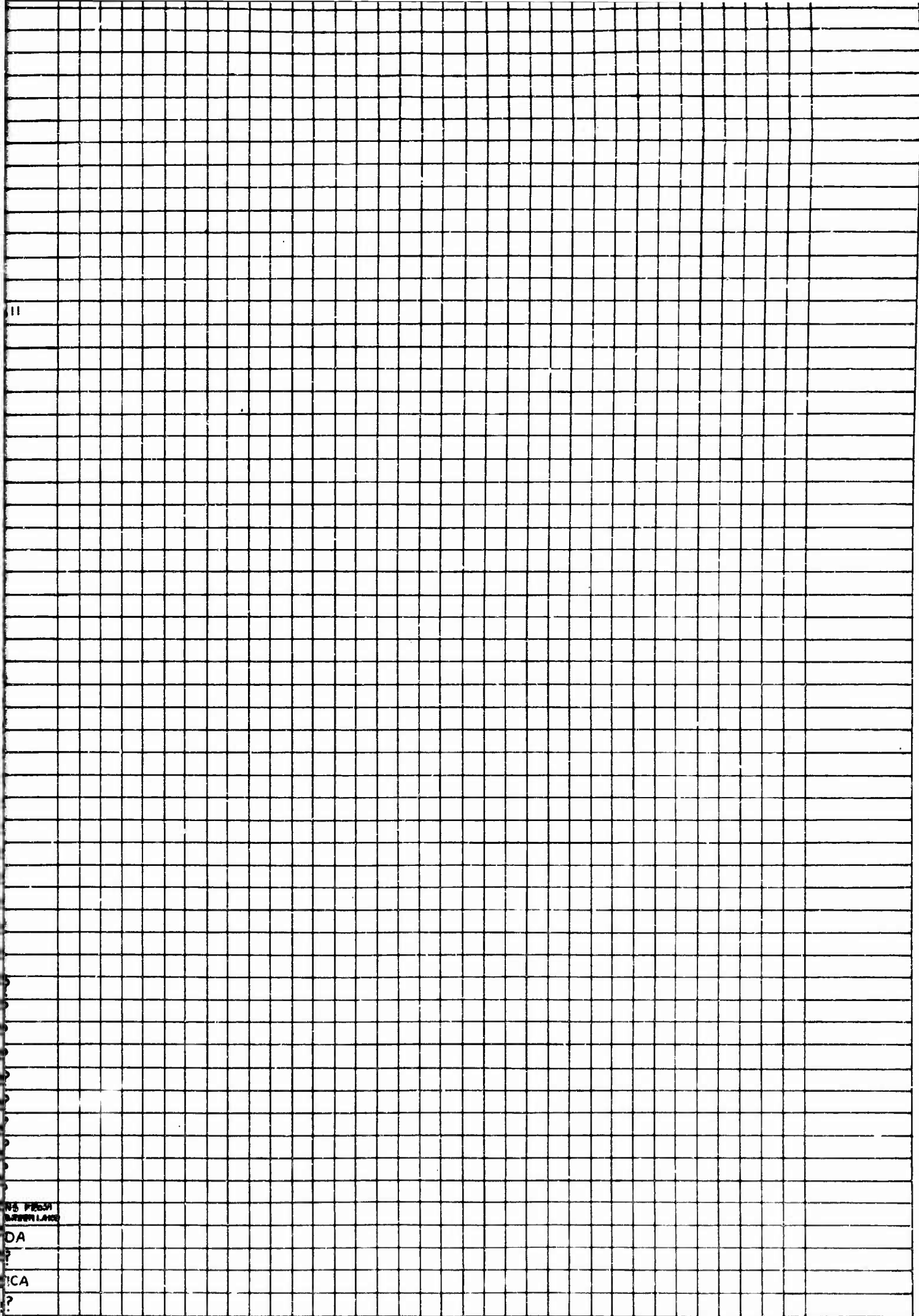
CANADA

?

ANTARTICA

?

I



NS FISH  
GREEN LAKE

DA

?

ICA

?

5

FIGURE 1

AREAS OF RESEARCH (CONSTITUENTS)			PROJECTS AND WORK UNITS (DETERMINATION OF CHARACTERISTICS)			TYPE OF EFFORT								GASEOUS FORMS															
						01 STUDY/ANALYSIS 02 LABORATORY RESEARCH AND EXPERIMENTS 03 FIELD LABORATORY OBSERVATION 04 FIELD OBSERVATION AND EXPERIMENTS 05 DEVELOPMENT 06 CONSTRUCTION / PRODUCTION 07 OPERATIONS 08 SUPPORT SERVICES								AIR MASSSES				AIR MIXTURES				MOTION							
														POLAR				EQUATORIAL				BASIC CONTAMINANTS				TRANSLATIONS PERSISTANT WINDS EPISODICAL WINDS VERTICAL WINDS			
A			CODE			OVERALL CHARACTERISTIC		DETERMINATION OF CONSTITUENTS		STRUCTURE		MECHANICAL		ELECTROMAGNETIC		THERMODYNAMIC		PROPERTIES		BASIC SCIENCES		SPACE							
						00		01		02		03		04		05		00		01		02		03		04		05	
																				211026		NASA						211026	
																								NASA USAF		NASA			



[illegible]

SPACE					ATMOSPHERE							
METARY	SOLAR	LUNAR	INTERSTITIAL SPACE	SPACE ATMOSPHERE INTERFACE	ATMOSPHERE GENERAL	EXOSPHERE	HETEROSPHERE	THERMOSPHERE	IONOSPHERE	MESOSPHERE	BOMOSPHERE	CHEMOSPHERE
04	05	06	07	08	09	10	11	12	13	14	15	16
	211026				211026 211-097 082-164 AEC							
SA AF	NASA				211068 082-212				NASA			
	211-099 NASA											







E

# MENTATION AND EQUIPMENT

RS	ENERGY SUPPLY	DATA PROCESS							
138	ELECTROSTATIC								
139	CHEMICAL								
140	ENERGY CONVERSION								
141	STORED ENERGY								
142	STORAGE RETRIEVAL								
143	COMPUTATION								
144	CONTROLS								
145	DISPLAYS								
146	COMMUNICATION								
147	SIMULATION								
148	PROBE SYSTEMS								

PROJECT/WORK UNIT CODE						PROJECT/WORK UNIT CODE						
TYPE OF PORT	SPECIFIC CONSTITUENT FACILITY OR EQUIV.	OPERATION FACILITY OR VEHICLE	SUPPLY FACILITY OR VEHICLE	GEOGRAPHIC LOCATION	COST IN 1000's	PROJECT/WORK UNIT NUMBER	TYPE OF EFFORT	SPECIFIC CONSTITUENTS FACILITY OR EQUIV.	OPERATION FACILITY OR VEHICLE	SUPPLY FACILITY OR VEHICLE	GEOGRAPHIC LOCATION	COST IN 1000's
	SPECIFIC CHARACTERISTICS							SPECIFIC CHARACTERISTICS				
04	00\09	129	119	?	?	01\17 NASA	04,07	03\70	129	148	?	?
04	00\88	129,134	119	?	?	01\17 NASA	04,07	03\95	129	134		
04	00\95	129,134	119	?	?	00\17 NASA	04,07	00\95	129	134		
08	00\129	129	119	MINN.	23	14\32 NASA	05	00\129	126	129		
08	00\144	129	119	MINN.	1	01\05 NASA	04,07	01\88	129	134		
04	08,11,30\17	129	119	CONTINENTAL U.S.	35	04\17 NASA	04,07	04\93	129	134		
04	09\129	129	119	MASS.	50	14\32 NASA	05,07	00\129	126	129		
08	01\09	119	32,33	WASH. D.C.	3	01\13 NASA	04,07	03\92	129	134		
01	04,05\129	119	143	N. Y.	21	00\02 NASA	04,07	00\87	129	134		
04	02\37,83	129,139	119	KWAJALIEN	0	10\17 NASA	04,07	10\98	129	134		
08	00\09,95,144	129	119	TEXAS	11	01\04 NASA	04,07	01\09	129	148		
0	TRAINING	129	119	MINN.	0	14\17 NASA	05	00\126	129	148		
0	09\17	119	143	S. DAKOTA	5	04\05 NASA	04,07	04\88	129	134		
05	00\129	129	119	MINN.	40	14\17 NASA	05,07	14\134	129	134		
08	00\09,95	129	119	CHURCHILL	350							
05	00\129,144	129	119	S. DAKOTA	1	10\17 USAF	04,07	24,25\92	129	134		
08	00\95,129	129	119	MINN.	44	06\18 USAF	04,07	51\83	129	139	11 STATIONS CANAL ZONE TO GREENLAND	
0	00\97,100	119	119	WASH. D.C.	30	01\17 USAF	04,07	03\101,102	129	134	CANADA	
0	LOGISTIC SUPPORT	LOGISTIC	119	MINN.	2	01\04 USAF	04,07	01\09,26	129	134		
0	00\17,96,97	129	119	CALIF.	0							
05	00\129	119	119	MINN.	42	01\17 BU STANDARDS	04,07	03\35	129	134		
08	14\102,129	129	119	MINN.	28	01\17 AEC WEATHERB.	04,07	03\97	129	134	ANTARTICA	
04	04\92	129	119	TEXAS	10	00\09 AEC	04,07	00\88	129	134		
08	00\87	129	119	CHURCHILL	418							
08	03\98	129	119	CANADA	116							
0	25\88	129	119	MASS.	65							
08	14\127	127	119	CHURCHILL	59							
08	LOGISTIC SUPPORT	129	119	CALIF	?							
05	00\122,131	131	122,123	MICHIGAN	27							
08	00\95	129	131	S. DAKOTA	7.5							
0	11\21,37	147	119	FLORIDA	28							
0	26\37,38,71	147	119	NEW MEXICO	29							
0	09\16,43	147	119	MARYLAND	27							
0	16\37	147	119	MASS.	18							
0	19,28\13,81	143	119	ARIZONA	20							
0	19,28\13,81	143	119	ARIZONA	1							

K

ELECTROMAGNETIC	
DIELECTRIC CONSTANT	18
RADIOACTIVITY	19
MAGNETIC PROPERTIES	20
ELECTROSTATIC PROPERTIES	21
ISOTROPICITY	22
PERMEABILITY	23
INDEX OF REFRACTION	24
COLOR (SPECTRA)	25
ELECTRIC POTENTIAL	26
	27
THERMODYNAMIC	
TEMPERATURE	28
COEFFICIENT OF THERMAL EXPANSION	29
THERMAL CONDUCTIVITY	30
SPECIFIC HEAT	31
MELTING POINT	32
HEAT OF REACTION	33
ENTROPY	34
	35
	36
CHEMICAL	
ATOMIC NO.	37
ATOMIC WEIGHT	38
MOLECULAR WEIGHT	39
LIGANCY	40
OXIDATION STATE	41
FORMAL CHARGE	42
VOLATILITY	43
SOLUBILITY	44
EQUILIBRIUM CONSTANT	45
BOND LENGTH	46
FORCE CONSTANT	47
BOND STRENGTH	48
DIPOLE MOMENT	49
POLARIZABILITY	50
CONCENTRATION	51
	52
BIOLOGICAL	
PHYSICAL CHARACTERISTICS	53
CHEMICAL COMPOSITION	54
METABOLIC REQUIREMENT	55
ENVIRONMENT REQUIREMENT	56
BY PRODUCTS	57
SUSCEPTIBILITY	58
GROWTH	59
REPRODUCTION	60
BEHAVIOR	61
	62
	63

SYNOPTI		DYNAMIC					PROPERTY			
SUPPORT/ DEVELOPMENT	14	PROPERTIES					STRUCTURE	BIOLOGICAL	CHEMICAL	THERMODYNAMIC ELECTRIC
		BIOLOGICAL	CHEMICAL	THERMODYNAMIC	ELECTROMAGNETIC	MECHANICAL				
		13	12	11	10	09	08	07	06	05
	</									

**082-178**

**082-094**

**211-097**

6.

1

USAF

083-003-13

211035

082-188  
082-210  
082-216  
082-226  
082-228  
082-241

082-172  
082-187  
082-211

083-046-3  
083-060-6

NASA  
USAF

082-167  
082-219  
082-221  
082-233  
082-240  
082-244

082-124  
083-046-4

082-154

082-154  
082-232  
082-246  
082-226

083-036-7

NASA  
NASA

. H

1

[illegible]

04,08	00\95	129	131	MICHIGAN	27
02	11\21,37	147	119	FLORIDA	28
02	26\37,38,71	147	119	NEW MEXICO	29
02	09\16,43	147	119	MARYLAND	27
02	16\37	147	119	MASS.	18
02	19,28\13,81	143	119	ARIZONA	20
02	19,28\13,81	143	119	ARIZONA	1
01	00\37,71	143	119	ARIZONA	38
01,04	10\16,87	143	119	NEW MEXICO	25
03	09\21,50	147	119	FLORIDA	60
05	01\18 00\148	131	119	MASS.	25
01,04	12,14\25,113	136	119	NEW MEXICO	13
01,04	25\92,93,94	134	119,127	ARIZONA	25
04	09\16	134	119	NEW YORK	39
01	03\37	143,148	119	COLORADO	30
04	00\80	120	119	ARIZONA	25
02,04	51\82	139	119	GERMANY	3
04	10\104,105	138	119	ENGLAND	13
04	10\104	134	119	CALIF.	8
04	33,51\37,82,116	123,127,128	119	HAWAII	54
02	09\37,104	147	119	WASH. D.C.	36
05	00\129	129	119,123	CALIF.	13
01	04\37,71	143	119	ARIZONA	40
01	04\83	143	119	ARIZONA	1
04	03\37	134	119	CALIF.	24
02	16\37	?	119	CALIF.	25
02	26\37,38,71	138	119	N.Y.	16
01	00\105,117	?	119	CALIF.	20
02	08,11\37,71	147	119	NEVADA	25
02	08\37,71,95	?	119	N.Y.	30
01	00\37,71	?	119	CALIF.	55
01	11\16	143	119	MASS.	4
04	26\37,113	134,143	119	NEW MEXICO	?
04	00\16,89	134	119	FLORIDA	19
01	00\16,37,104	142	119	N.Y.	12
01	10\16,117	142,143	119	RHODE ISLAND	35
04	04,10\10	134	122,123	FLORIDA	10
01	10\138	142\143	119	CALIF.	11
01	34\09	143	119	ILLINOIS	11
04	51\36,82	123	139,142	TROPICS	11,3
02,04	03\16,43	123	136,147	CHESAPEAKE B.	103
04,08	00,20	123	143	GULF OF MEX.	37
04	44\09,81	123	139	GULF OF MEX.	43
04	00\13,35	123	?	?	22
04	02\13,16	122,123	136	LONG ISLAND SOUND	89
04	24\36,93	123	134	?	60
04	07\10,56	123	136	BAHAMA BANK	69
04	09,11,12\13,14,15	123	134,136	?	60

J



FIGURE 4

FACILITIES - VEHICLES - SUPPORT - SERVICES						RESEARCH LABORATORIES DEVELOPMENT LABORATORIES OPTICAL OBSERVATORIES		
RESEARCH FLEET						01	02	03
SHIP	FACILITIES	VEHICLES FOR DEPLOYMENT	SUPPORT SERVICES	EQUIPMENT COST	OPERATING COST/YR.			
A	AIRCRAFT CARRIER	GEOGRAPHICAL SCIENCE RESEARCH LABORATORY				01		
		OCEAN SCIENCE RESEARCH LABORATORY				02		
		ATMOSPHERIC SCIENCE RESEARCH LABORATORY				03		
		SPACE SCIENCE RESEARCH LABORATORY				04		
		EQUIPMENT DEVELOPMENT LABORATORY				05		
		OPTICAL OBSERVATORY				06		
		RADIO/ RADAR OBSERVATORY				07		
		PHYSICAL OBSERVATORY				08		
		TRACKING NETWORK				09		
		COMMUNICATIONS NETWORK				10		
		DATA PROCESSING FACILITY				11		
		SIMULATION AND TEST LABORATORY				12		
		LAND SURFACE VEHICLES				13		
		SUBTERRANEAN VEHICLES				14		
		BOATS				15		
		AMPHIBIOUS CRAFT				16		
		SUBMERSIBLES				17		
		UNDERSEA BASES				18		
		BUOYS				19		
		FIXED WING AIRCRAFT				20		
		ROTARY WING AIRCRAFT				21		
		BALLOONS				22		
		SOUNDING ROCKETS				23		
		BOOSTERS/ SPACECRAFT (LIMITED)				24		
		PERSONNEL				25		
		MAINTENANCE AND REPAIR				26		
		CONSTRUCTION (LIMITED)				27		
		FOOD AND HOUSING				28		
		MEDICAL				29		
		SUPPLY				30		
		RECOVERY RESCUE AND SURVIVAL				31		
		ADM. LIBRARY, CLASSROOMS				32		
		CLERICAL, DRAFTING, ETC.				33		
		RECREATION				34		

1

AREAS  
NET



## ES - VEHICLES - SUPPORT - SERVICES

[illegible]

E

[illegible]

11

SPACE

FACILITIES										SPACE VEHICLE OPERATIONS								DEPLOYED VEHICLE OPERATIONS				SUPPORT SERVICES								GEOGRAPHICAL LOCATION		
OPTICAL OBSERVATORIES										EARTH ORBITING SATELLITES AND STATIONS								SPACE PROBES				PERSONNEL (FUTURE)								136		
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132			133
RADIO/TELEVISION OBSERVATORIES										PLANETARY ORBITING SATELLITES AND STATIONS								BOOSTERS				MAINTENANCE AND REPAIR (FUTURE)										
PHYSICAL OBSERVATORIES										SOLAR ORBITING SATELLITES AND STATIONS								LIFTING BODIES				FOOD AND HOUSING										
TRACKING										SPACECRAFT								BALLOONS				MEDICAL (FUTURE)										
COMMUNICATIONS																						SUPPLY (FUTURE)										
DATA PROCESSING																						RECOVERY, RESCUE AND SURVIVAL LIMITED ADMINISTRATION (FUTURE)										
SIMULATION AND TEST (FUTURE)																						RECREATION (FUTURE)										
INSTRUMENTATION & EQUIPMENT																						TRANSPORTATION										



				AND REPAIR	27			
				CONSTRUCTION (LIMITED)	28			
				FOOD AND HOUSING	29			
				MEDICAL	30			
				SUPPLY	31			
				RECOVERY RESCUE AND SURVIVAL	32			
				ADM. LIBRARY, CLASSROOMS CLERICAL, DRAFTING, ETC.	33			
				RECREATION	34			
				TRANSPORTATION	35			
					36			
				TOTAL ENVIRONMENT SENSING EQUIPMENT	37			
				TOTAL ENVIRONMENT SAMPLING EQUIPMENT	38			
				ENVIRONMENT ALTERATION EQUIPMENT	39			
				SURVEYING EQUIPMENT	40			
ATMOSPHERIC & OCEAN SCIENCES RESEARCH VESSELS				TRACKING NETWORK	41			
				COMMUNICATIONS NETWORK	42			
				DATA PROCESSING EQUIPMENT (RELAY)	43			
				SOUNDING AND TETHERED BALLOONS	44			
				ATMOSPHERE AND OCEAN PROBES	45			
				BOATS AND BUOYS	46			
				DIVERS	47			
				CREW AND LIMITED RESEARCH PERSONNEL	48			
					49			
				TOTAL ENVIRONMENT SENSING EQUIPMENT	50			
				TOTAL ENVIRONMENT SAMPLING EQUIPMENT	51			
				ENVIRONMENT ALTERATION EQUIPMENT	52			
				SURVEYING EQUIPMENT	53			
				TRACKING NETWORK	54			
SUBMARINES				COMMUNICATIONS NETWORK	55			
				DATA PROCESSING EQUIPMENT (RELAY)	56			
				BOATS	57			
				BUOYS	58			
				PROBES	59			
				DIVERS	60			
				CREW AND LIMITED RESEARCH PERSONNEL	61			
					62			
				TRACKING NETWORK	63			
				COMMUNICATIONS NETWORK	64			
				DATA PROCESSING EQUIPMENT (RELAY)	65			
				SOUNDING AND TETHERED BALLOONS	66			
				BUOYS	67			
				BOATS	68			
SUPPORT VESSELS (DESTROYER CLASS)				DIVERS (LIMITED)	69			
				PLANE GUARD	70			
				RECOVERY RESCUE AND SURVIVAL	71			
				ICE BREAKING	72			
				TRANSPORTATION	73			
					74			
				TRACKING NETWORK (LIMITED)	75			
				COMMUNICATIONS NETWORK (LIMITED)	76			
				DATA PROCESSING RELAY (LIMITED)	77			
				SOUNDING AND TETHERED BALLOONS (LIMITED)	78			
				BUOYS (LIMITED)	79			
				BOATS (LIMITED)	80			
				SUPPLY	81			
				TRANSPORTATION	82			
SUPPLY VESSELS								

G

27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82

ACCESS TO MOST INLAND AREAS  
VIA SHIP, BOAT & AIRCRAFT  
TRANSPORTATION

ACCESS TO THE LAND/OCEAN & LAND/ATMOSPHERE  
INTERFACES WITH SIMULTANEOUS MEASUREMENT  
CAPABILITY

I

ACCESS TO THE LAND/OCEAN & LAND/ATMOSPHERE  
INTERFACES WITH SIMULTANEOUS MEASUREMENT  
CAPABILITY

ACCESS TO MOST INLAND AREAS  
VIA SHIP, BOAT & AIRCRAFT  
TRANSPORTATION

51

ACCESS TO THE OCEAN/ATMOSPHERE  
INTERFACE WITH SIMULTANEOUS MEASUREMENT  
CAPABILITY

ACCESS TO ANY DEPTH  
OF BODIES OF WATER

ACCESS TO MOST LANDLOCK  
OF WATER VIA AIRCRAFT TRA

ACCESS TO THE ATMOSPHERE/SPACE  
INTERFACE WITH SIMULTANEOUS  
MEASUREMENT CAPABILITY

ACCESS TO ANY ALTITUDE DUE TO  
HIGH ALTITUDE BALLOON CAPABILITY



K

ACCESS TO THE ATMOSPHERE / SPACE  
INTERFACE WITH SIMULTANEOUS  
MEASUREMENT CAPABILITY

ACCESS TO ANY ALTITUDE DUE TO  
HIGH ALTITUDE BALLOON CAPABILITY

ACCESS TO MEASUREMENT OF SOLAR & OTHER EXTRATERRESTRIAL  
ENERGY SOURCES WITH MEASUREMENTS COORDINATED SIMULTANEOUSLY  
WITH ATMOSPHERE, LAND & SEA MEASUREMENTS





1

LAND	
------	--

S		LAND VEHICLE OPERATION		DEPLOYED VEHICLE OPERATIONS					SUPPORT SERVICES												FACILITIES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
DATA PROCESSING		SIMULATION & TESTS		TOTAL NUMBER		SUBTERRANEAN		SURFACE		FIXED WING AIRCRAFT		ROTARY WING AIRCRAFT		SOUNDING / ROCKETS		BOOSTERS / SPACECRAFT		BALLOONS		TOTAL NUMBER		PERSONNEL		MAINTENANCE & REPAIR		CONSTRUCTION		FOOD & HOUSING		MEDICAL		SUPPLY		RECOVERY, RESCUE & SURVIVAL		ADMINISTRATION		RECREATION		TRANSPORTATION		TOTAL NUMBER		LAND BASED COMPLEX		GEOGRAPHICAL COVERAGE		LOCAL AREA COVERAGE		RESEARCH LABORATORIES		DEVELOPMENT LABORATORIES		OPTICAL OBSERVATIONS		RADIO / RADAR OBSERVATORIES		PHYSICAL OBSERVATION		TRACKING		COMMUNICATIONS		DATA PROCESSING																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
08																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		





11

SP

[illegible]

# SPACE

SPACE VEHICLE OPERATIONS						DEPLOYED VEHICLE OPERATIONS						SUPPORT SERVICES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
SPACE PROBES						TOTAL NUMBER						TOTAL NUMBER						PERSONNEL (FUTURE)						MAINTENANCE & REPAIR (FUTURE)						CONSTRUCTION (FUTURE)						FOOD & HOUSING						MEDICAL (FUTURE)						SUPPLY (FUTURE)						RECOVERY, RESCUE & SURVIVAL (LIMITED)						ADMINISTRATION (FUTURE)						RECREATION (FUTURE)						TRANSPORTATION						TOTAL NUMBER						SPACE COMPLEX						GEOGRAPHICAL LOCATION						LOCAL AREA COVERAGE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
							6						4												10																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</



# OPERATIONAL PARAMETERS

			RESEARCH LABORATORIES	DEVELOPMENT LABORATORIES	OPTICAL OBSERVATORIES	RADIO / RADAR OBSERVATORIES	PHYSICAL OBSERVATORIES	TRACKING	COMMUNICATIONS	DATA PROCESSING	SIMULATION & TEST	TOTAL NUMBER	SUBTERRANEAN	SURFACE	FIXED WING AIRCRAFT	ROTOR WING AIRCRAFT
			01	02	03	04	05	06	07	08	09	10	11	12	13	14
CAPABILITY	NUMBER OF DIFFERENT	FACILITIES	01									9				
		VEHICLE OPERATIONS	02										2			
		DEPLOYABLE VEHICLE OPERATIONS	03													
		SUPPORT SERVICES	04													
FLEXIBILITY		GEOGRAPHICAL COVERAGE	05													
		LOCAL AREA COVERAGE	06													
		MOBILITY	07										L	R	L	L
		INDIVIDUAL RESEARCH EFFORT	SPACE	08												
			SPACE/ATMOSPHERE INTERFACE	09												
			ATMOSPHERE	10												
			ATMOSPHERE/HYDROSPHERE	11												
			HYDROSPHERE	12												
			HYDROSPHERE/LITHOSPHERE INT.	13												
			LITHOSPHERE	14												
			LITHOSPHERE/ATMOSPHERE INT.	15												
		SIMULTANEOUS RESEARCH EFFORT	SPACE	16												
			SPACE ATMOSPHERE INT.	17												
			ATMOSPHERE	18												
			ATMOSPHERE / HYDROSPHERE INT.	19												
			HYDROSPHERE	20												
			HYDROSPHERE/LITHOSPHERE INT.	21												
			LITHOSPHERE	22												
			LITHOSPHERE/ATMOSPHERE INT.	23												
AVAILABILITY		MONTHS	24	U	U	L	L	L	L	U	U		L	L	L	L
		DAYS	25	U	U	L	L	L	L	U	U		L	L	L	L
		DAY OPERATIONS	26	U	U	L	L	L	L	U	U		L	L	L	L
		NIGHT OPERATIONS	27	U	U	L	L	L	L	U	U		L	L	L	L
		ALL WEATHER OPER.	28	U	U	L	L	L	L	U	U		L	L	L	L
COST		INITIAL	29													
		OPERATING	30													
OTHER			31													
			32													
			33													
			34													
			35													



[illegible]

63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
FOOD & HOUSING									MEDICAL									SUPPLY									RECOVERY, RES & SURVIVAL									ADMINISTRATIVE									RECREATION									TRANSPORT									TOTAL NUM									SEA BASED C									GEOGRAPHIC LOCATION									LOCAL AREA COVERAGE									RESEARCH LABORATORIES									OPTICAL OBSERVATORIES									RADIO / RADAR OBSERVATORIES									PHYSICAL OBSERVATORIES									TRACKING									COMMUNICATION									DATA PROCESSING									SIMULATION (LIMITED)									TOTAL NUM									FIXED WING AIRCRAFT									ROTORARY WING AIRCRAFT									SOUNDING ROX									BALLOONS									TOTAL NUM									SOUNDING ROX									BOOSTERS/SPA									TOTAL NUM									PERSONNEL (LIMITED)									MAINTENANCE (LIMITED)									FOOD & HOUSING (LIMITED)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
																		0							4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

5



[illegible]



A

FACILITIES VEHICLES SUPPORT SERVICES						AIRCRAFT																		
PROJECTS AND WORK UNITS						FACILITIES										VEHICLES FOR								
						GEOGRAPHICAL SCIENCES RESEARCH LABORATORIES	OCEAN SCIENCES RESEARCH LABORATORY	SPACE SCIENCES RESEARCH LABORATORY	ATMOSPHERIC SCIENCE RESEARCH LABORATORY	EQUIPMENT DEVELOPMENT LABORATORY	OPTICAL OBSERVATORY	RADIO / RADAR OBSERVATORY	ACOUSTICAL OBSERVATORY (SONAR)	PHYSICAL OBSERVATORY	TRACKING NETWORK	COMMUNICATIONS NETWORK	DATA PROCESSING FACILITY	SIMULATION AND TEST LABORATORY	LAND SURFACE VEHICLES	SUBTERRANEAN VEHICLES	BOATS	AMPHIBIOUS CRAFT	SUBMERSIBLES	AIRCRAFT
AGENCY CONTRACTOR	PROJECT OR WORK UNIT NUMBER	SPECIFIC CONSTITUENT SPECIFIC CHARACTERISTIC	WORK UNIT COST (THOU.)	SUPPORT COST (THOU.)		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
ONR /CONVAIR	211026	OVERALL CHARACTERISTICS ATM. GENERAL	?			01																		
ONR /CONVAIR	211026	OVERALL CHARACTERISTICS SOLAR GAMMA RAY/RADIATION	?			02																		
ONR /GEN.MILLS	211055	VELOCITY, ARES OF TEND, TRANSLATION, THERMAL COND. MOTION	35			03																		
ONR /A.D.LITTLE	211064	MECHANICAL DYNAMICS BALLOONS	50			04																		
ONR /NRL	211068	STRUCTURE WATER VAPOR, OZONE	0			05																		
ONR /RAVEN INDUSTRIES	211069	OVERALL CHARACTERISTICS ATM., COSMIC RAYS, BALLOONS, CATALYTIC	11			06																		
ONR /GENERAL DYNAMICS	211-026	OVERALL CHARACTERISTICS UPPER ATM. PHYSICS, X-RAY, GAMMA RAY	0			07																		
ONR /BU. OF STANDARDS	211-096	ELECTROMAGNETIC PROPERTIES INFRARED RADIATION	10			08																		
ONR /WYNNEN RESEARCH	211-097	SUPPORT BALLOON FLIGHTS, RADIATION	418			09																		
ONR /SCHJELDHALE	211-098	PRECIPITATION ELECTRONS	116			10																		
ONR /JOHN HOPKINS U.	211-099	SPECTRUM SOLAR RADIATION, DATA REDUCTION	65			11																		
ONR /RAVEN INDUSTRIES	211-100	SUPPORT AIRCRAFT, BALLOON TRACKING	59			12																		
ONR /UNIV. OF CALIF.	211-101	LOGISTIC SUPPORT	?			13																		
ONR /RAVEN INDUSTRIES	211-103	OVERALL CHARACTERISTICS BALLOON FLT FOR GALACTIC COSMIC RAYS	75			14																		
ONR /MOTS-OMMA LAKE, CALIF.	211-104	OVERALL CHARACTERISTICS TETHERED BALLOONS	13			15																		
ONR /N.M. INST. OF MINING	082-167	ELECTROMAGNETIC PROPERTIES THUNDERSTORMS, ENERGY EXG.	25			16																		
ONR /FLORIDA STATE U.	082-172	MECHANICAL PROPERTIES ATM & FLUID CIRCULATION	60			17																		
ONR /N.M. INST. OF MINING	082-178	ACOUSTICAL FREQUENCY THUNDERSTORM PRESS. OSCILLATIONS	13			18																		
ONR /INST. OF ATM. PHYSICS	082-182	SPECTRA LIGHTNING RADIATION UV-IR	25			19																		
ONR /CORNELL AERO. LAB.	082-187	Mech. PROPERTIES HORIZ. & VERT. ATM. MOTIONS	39			20																		
ONR /INST. OF ATM. PHYSICS	082-191	OVERALL CHANGES OF WEATHER SURFACE COVER	25			21																		
ONR /PHYSIKALISCH-BECKMANSCHE	082-192	CONCENTRATION HITROUS OXIDES, NITRATE IONS	3			22																		
ONR /DURHAM UNIV.	082-199	ELECTRIC PROPERTIES ELECTRIC FIELDS IN ATM.	13			23																		
ONR /STANFORD RES. INST.	082-206	ELECTRIC PROPERTIES ELECTRIC FIELDS OF ATM.	8			24																		
ONR /UNIV. OF HAWAII	082-210	HEAT OF CONDENSATION SODIUM CHLORIDE, CLOUD FORMATION	54			25																		
ONR /SCRIPPS INST. OF OCEANOGRAPHY	083-005-13	CONCENTRATION CO <sub>2</sub> IN SEA WATER	11.3			26																		
ONR /JOHN HOPKINS U.	083-016-2	MECHANICAL PROPERTIES WIND WAVES	103			27																		
ONR /TEXAS A&M UNIV.	083-036-4	OVERALL CHARACTERISTICS AIR-SEA INTERACTIONS	37			28																		
ONR /TEXAS A&M UNIV.	083-036-7	SOLUBILITY GAS & ORGANIC CARBON IN SEA WATER	43			29																		
ONR /TEXAS A&M UNIV.	083-036-8	OVERALL CHARACTERISTIC AIR-SEA INTERACTIONS	22			30																		
ONR /N.Y. UNIV.	083-046-3	STRUCTURE AIR TURBULENCE OVER SEA WATER	89			31																		
ONR /N.Y. UNIV.	083-046-4	REFLECTIVITY RADIANT ENERGY AT SEA SURFACE	60			32																		

## RESEARCH FLEET

AIRCRAFT CARRIER

**ATMOSPHERIC AND  
OCEAN SCIENCES  
RESEARCH VESSELS**

## SUBMAR

[illegible]



UNIV.	003-036-4	CHARACTERISTICS	INTERACTIONS	31	30
ONE TEXAS A&M UNIV.	083-036-7	SOLUBILITY	GAS & ORGANIC CARBON IN SEAWATER	43	29
ONE TEXAS A&M UNIV.	083-036-8	OVERALL CHARACTERISTIC	AIR-SEA INTERACTIONS	22	30
ONE N.Y. UNIV.	083-046-3	STRUCTURE	AIR TURBULENCE OVER SEA WATER	89	31
ONE N.Y. UNIV.	083-046-4	REFLECTIVITY	KINEMATIC ENERGY AT SEA SURFACE	60	32
ONE UNIV. OF MIAMI	083-060-6	OVERALL CHARACTERISTIC	ATM. & WAVE GENERATION	69	33
ONE OREGON STATE U.	083-102-2	MECHANICAL PROPERTIES	AIR-SEA INTERACTIONS	60	34
					35
NASA / ?	?	SCALE / DIMENSIONS	EXTRA-TERRESTRIAL MATTER	?	36
NASA / ?	?	SCALE / DIMENSIONS	IONIZING RADIATION	?	37
NASA / ?	?	OVERALL CHARACTERISTICS	IONIZING RADIATION	?	38
NASA / ?	?	OVERALL STRUCTURE	ELECTROMAGNETIC RADIATION	?	39
NASA / ?	?	OVERALL ELECTRO-MAGNETIC CHARACTERISTICS	VISIBLE RADIATION	?	40
NASA / ?	?	OVERALL CHARACTERISTICS	INFRARED RADIATION	?	41
NASA / ?	?	OVERALL CHARACTERISTICS	SPACE ENERGY	?	42
NASA / ?	?	ELECTROMAGNETIC PROPERTIES	BETA-RAYS (ELECTRONS)	?	43
NASA / ?	?	OVERALL CHARACTERISTICS	PLANETARY GASEOUS FORMS	?	44
NASA / ?	?				45
NASA / ?	?				46
NASA / ?	?				47
NASA / ?	?				48
NASA / ?	?				49
USAF / ?	?	OPTICAL CHARACTERISTICS	INFRARED RADIATION	?	50
USAF / ?	?	CONCENTRATION	PORE SUBSTANCES IN ATM	?	51
USAF / ?	?	SCALE / DIMENSIONS	IONIZING PARTICLES	?	52
USAF / ?	?	DET. OF CONSTITUENTS	PLANETARY GASEOUS & LIQUID FORMS	?	53
BU. OF STDS. / ?	?				54
AEC, WEATHER BU. / ?	?	SCALE / DIMENSIONS	GAMMA RADIATION	?	55
AEC / ?	?	OVERALL CHARACTERISTICS	RADIATION	?	56
					57
					58
					59
					60
					61
					62
					63
					64
					65
					66
					67
					68
					69
					70
					71
					72
					73
					74
					75
					76
					77
					78
					79
					80
					81
					82





